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ABSTRACT

Four case studies were used to illustrate application of panel analysis in sociological research. The panel design requires that (a) identical units be reobserved; (b) identical criteria be employed; and (c) initial and subsequent observations be made at the same times for all units and all criteria. Units may be individuals, groups (such as families), ecological units, communities or countries. Relaxing the strict definition of panel design, the methods of analysis employed are restricted to questions of intention and action; plans and their realization; expectation and its fulfillment. Attempts to develop systems of social indicators presuppose monitoring, on a periodic basis, not only of the same aspects of life quality, but also the realization of plans and programs and effects of policies. Variables are taken into consideration, such as education level, employment, sex, religion, and group orientation. Reasons for changing opinions and for trends in thinking are analysed not only on the basis of the above variables but also in the light of the impact of recent events, economic changes, and exposure to different or new situations and ideas. (JD)

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ELEMENTS OF PANEL ANALYSIS

by

Jiri Nehnevajsa

Under the title "Analyse von Panel-Befragungen," this paper was published in Rene Koenig, ed., Handbuch der empirischen Socialforschung, Vol. 2, pp. 191-227, Ferdinand Enke, Stuttgart, 1973.

PANEL ANALYSIS

by

Jiri Nehnevajsa

In this discussion we shall briefly explore some of the methodological and analytical consequences of observing the same units upon the same variable(s) on two or more occasions. These units may be individuals, relationships, groups (such as families). They may be ecological units - communities, counties, districts.

This type of inquiry, panel research, differs from prediction studies in that the same variables are being observed, and the behavior of the sample units with respect to the variables can be analyzed. Panel research differs from repeated sample surveys in that the same units are studied so that it becomes possible to identify exactly all changes in terms of the criterion, and not merely the net change. We speak of trends when it comes to the study of net changes.

Clearly, repeated cross-sectional surveys establish "trends" in that different samples are repeatedly observed even though the variables may remain the same.

We can tell, for example, whether unemployment (rates) have been rising or declining, or how the popularity of a statesman has varied over time, and so on. (A fine brief summary of trend analysis is given, for instance, in Edwards, 1968). But we cannot say much about such things as the "stability of the labor market" for trend data do not tell us whether many of the previously employed people lost their jobs, and some, or even many, of the unemployed have found employment. Nor can we tell the extent to which people who had favored the policies of a particular statesman in the past have come to dislike the policies (or

the statement), and the degree to which people previously unimpressed may have come to like the policies later on.

In turn, in prediction studies, we can consider whether one state (value of a variable) is predictive of some other subsequent state; whether, for example, length of engagement "predicts" marital success, or whether (subsequent) migration rates are affected by economic difficulties of the outmigration country - or, for that matter, how they relate to economic conditions in the country of immigration. In such studies, the same units are being observed over time - but the variables are, ex definitione, different.

Figure 1.

SCHEMATIZATION OF PREDICTION, TREND AND PANEL STUDIES

Type of design	Units*	Variable(s)*
Trend studies	Different	Same
Prediction studies	Same	Different
Panel studies	Same	Same

*At least two time periods are postulated and the terms "different" and "same" refer to the relation between the time of the initial observations and the subsequent one(s).

The distinction between "trend," "prediction" and "panel" studies which we are stressing underlies the organization of such important research expository volumes as Language of Social Research (Lazarsfeld and Rosenberg) or L'Analyse des processus sociaux (Chazel, Boudon and Lazarsfeld).

In this sense, we shall employ the concept of "change" only in relation to the successive states of the same unit on the same variable(s):

that is, only in regard to the panel design. The variable which is repeatedly observed will be referred to as the "criterion" (of the panel study).

An individual may change his preference for a candidate. His interest in politics may change as to its level. The subject may change the brand of product he buys. A county may give a plurality to one political party in one election, but to another one in some subsequent (or previous) election. The family may be tuned in to one T.V. channel, and change to another channel in the next half hour. A sociometric relationship of mutual liking may change into a different type of relationship. (Bernard Berelson, Paul F. Lazarsfeld, W.N. McPhee 1954; A. Campbell, G. Gurin, W. E. Miller 1954; Helen Dinerman 1948/49; P. F. Lazarsfeld und Marjorie Fiske 1938; P. F. Lazarsfeld and B. Berelson 1944).

The concept which we utilize to describe the aggregate change with respect to some variable is that of turnover. It refers to all changers with regard to a given criterion.

II. QUASI-PANELS

In a strict manner, the panel design requires that:

(a) identical units be reobserved

(b) identical criteria employed, and

(c) initial and subsequent observations be made at the same times for all units and all criteria.

However, the methods of analysis which we are about to consider in this chapter can be used also if we slightly relax the most rigorous definition of panels. Indeed, the analytical procedures will prove as useful in the interpretation of quasi-panels - as we shall term all data to which the above strict definition does not apply - as they are in terms of strict panels.

Let us briefly consider relaxing the definition of the "unit". It turns out, that studies of generational mobility are quasi-panels in this context. It may well be argued that the unit is the same if re-defined as "family line" rather than "father's" and "son's" occupational statuses respectively. In any event, generational mobility tables can therefore be analyzed as if they were panel tables in the strict sense. (as an example, Goodman, 1969, Bertaux, 1969)

We may, on occasion, extend the definition of a criterion to include designs wherein we ask, first, about plans, intentions, anticipations of people and subsequently about their actions, about the manner in which they carry out their plans and intentions. It may be useful to label such a criterion an actualization criterion. (for example, Clausen, 1949 or Peter Rossi, 1952).

Here, we speak of the panel-like relationship between:

- intention and action
- plan and its realization
- expectation and its fulfillment.

Such actualization panels become important tools in evaluative and social planning research: the reobserved variable is not "identical" in the repeated measurement but it has to do with what does happen (subsequent observation) in contrast with what was supposed to happen (initial observation).

The attempts to develop systems of social indicators (see, for example, Bauer and Bidderman, 1966, Gross, 1969) at the U.S. national level presuppose monitoring, on a periodic basis, not only of the same aspects of life quality, but also of the realization of plans and programs, effects of policies and the like, even though this is but implicit in the work of the authors cited.

Finally, we can also relax the strict definition of "time" as it applies to panel-type studies. For example, life histories (see, for instance, Morrison, in Borgatta and Bohrstedt, 1969) of individuals, or of families, become analyzable as panels but changes which do occur (occupational shifts, births and deaths and the like) normally take place at different times for the various members of the "quasi-panel" so that the timings of observations are not held constant via research design, but are isomorphic to the actual life experiences of the units themselves. This means that the "initial observation" (or, let us say, some prior occupational status) may occur at different points in time for the different units, but if we want to control for such differences, we merely need to study people who have been in a particular occupation for the (approximately) same amount of time and compare them with those

who may have been in a particular occupation longer or shorter. This then means that "statistical" rather than "design" controls get exercised over the timing of observations, and it is altogether possible that the whole trajectory of life histories may have been actually collected at one and the same point in time (that is, at a particular time, the respondents may have been asked details about their past - their belief systems, occupational backgrounds, familial circumstances and the like - but the data are treated as if they were observations over time). In the same vein, we can ask respondents (or observe units by some other method) about their "recollections" and about their "anticipations" and obtain quasi-panel data acquired, however, at the same point in time. This is exemplified by questions regarding past, present (as of the time of interview) and expected "world tensions," or by data on past, present and expected satisfactoriness of various conditions of existence (satisfaction with life in general, with specific aspects thereof, and so on). Such quasi-panel data are, we repeat, obtained possibly in only one interview, but they pertain to the "recall" (past satisfactions, past perceptions, past experiences, past "facts") of some prior state of affairs relative to the present and, perhaps, to expectations about the future.[1]

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[1] In the way of a concrete example, I have now carried out six nation-wide (U.S.) cross-sectional studies of attitudes regarding peace and war issues (under the sponsorship of the Office of Civil Defense). Typical of the quasi-panel questions are those which have asked the American respondents to rate (on a scale of 0-10) the "level of international tensions"

- currently prevailing
- anticipated in two years
- anticipated in five years
- as recalled about two years ago (prior to the study).

The studies referred to have been conducted in 1963, 1964, 1966, 1968 and 1972. The data form "quasi-panel" table.

We cannot deal with the special problems in interpretation which are raised with the different types of quasi-panel data. Suffice it to say that the formal aspects of panel analysis remain meaningful whether we deal with strict panels or with quasi-panels. The techniques to be outlined hereafter are therefore applicable directly, even though the special problems raised by each research design call for a different type of "Verstehen."

III. TURNOVER TABLES

In the classical Elmira investigation of the 1948 presidential election, the respondents were asked both in June and October: B. Berelson, P.F. Lazarsfeld, W.N. McPhee, 1954):

> "Do you generally expect that this country will be in another war within the next ten years or so, or do you think there is a good chance of avoiding it?" (2, s. 16)

We can present these results in the form in which they lend themselves best to panel analysis. A typical dichotomous turnover table results:

Table 1.

EXPECTATIONS OF WAR IN ELMIRA, N. Y. 1948

October 1948 (Time 2)

		Expect War		Do Not		
		N	Transition Probability	N	Transition Probability	TOTAL
June 1948 (Time 1)	Expect War	195	.80	48	.20	242
	Do Not	141	.39	221	.61	362
	TOTAL	336		268		604

First, we observe the marginal (net) change. We find that the proportion of more pessimistic people increased by 16 per cent (from 40 per cent in June to 56 in October). This information would have been obtained even had different respondents been interviewed each time. Clearly, we would be interested in explaining this trend. We know that most characteristics of the respondents remained the same, thus not greatly helping us to account for the shift. We are directed to look into the relevant environment - to some external event(s) for plausible explanations. It turns out that, between the two interviews, the Berlin

blockade started, and it is not unreasonable to argue that this substantively explains the trend toward pessimism regarding chances for world peace.

The information we gain by employing a panel design is confined to the cells of the table; the respective entries were known only because the same subjects were studied both times. While the 16 per cent trend points to a shift of 93 respondents, we see that 189 of them actually changed. In face of a trend toward pessimism, 48 subjects became more optimistic about prospects for peace (8 per cent of the total panel).

How to interpret this result is a matter different from simply establishing that the changes did take place. We might argue that these 48 subjects did not even know of the Blockade and thus could not have been influenced by it (provided it was influential at all - something we suspect but do not know). But this is a little too farfetched. It is more likely that the events in Berlin may have had different saliency for different people. Thus some respondents may well have viewed it mainly from the standpoint of the Air-Lift. They may have thought that since the Soviet challenge had been effectively met, the Berlin experience served as a deterrent to another war rather than increased its likelihood. There is more to the story, however - and it is an ex post facto story as need be realized. Even had our subjects seen the Berlin conditions in the same light, the drift toward optimism on the part of some of them may be explained: the Stalin-Tito breach also occurred between the two interviews. It would suffice to establish that for some respondents the Soviet-Yugoslav situation seemed more relevant in terms of peace or war than even the Berlin crisis.

Now we do not propose to interpret the results fully. Let it be made clear that various influences entered the situation, and that our data quite probably confound their relative impacts. We shall

shortly indicate that we do not have to settle for ex post facto interpretations if we build perceptions of actual or likely events directly into our research design.

In our turnover table, turnover can then simply be measured by the sum of the transition probabilities in the non-diagonal cells. This index would yield .59 - and it would be revealing only were we to compare this magnitude of turnover with that obtained in some other group, or with respect to another criterion. Berelson, Lazarsfeld and McPhee, for instance, go on to state that party preferences were more stable (there was less turnover) than subsidiary issues - such as war-expectations.[2]

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[2] In the index mentioned we take $a_{12} + a_{21}$ as the turnover measure [wherein $a_{ij} = \frac{n_{ij}}{n_{i.}}$ and (ij) refer, to the row,(i),and column, (j), designation, with n_{ij} being the frequency in the ith row and jth column, and $n_{i.}$ the frequency over all j's in the i'th row. The a_{ij}'s are thus transition probabilities: given that the respondent is in state "i" on the first occasion, what are the (empirical) odds that the unit will be in state "j" on the second occasion; when i=j, we are dealing with units, here individuals, whose opinion did not change at all].

Other ways of measuring turnover have, of course, been proposed. For one, we may see the actual frequency of changers as depending on the maximum number of changers and a minimum number of them given the marginals. In the Elmira table, the minimum number of changers would be 93, and the maximum, in turn, 578 as the reader should verify. Such an index would have the form $\frac{189 - 94}{578 - 94} = .196$ or in general, $\frac{\text{actual} - \text{minimum}}{\text{maximum} - \text{minimum}}$.

This index is, unfortunately, highly sensitive to the size of the smallest marginal, and this means that the marginal skewness has an important effect on its value. The intuitively appealing measure (because it can range from "maximum" to "minimum" possible turnover - from 1.00 to 0) is not a very good one.

The maximin index is at the root of such measures as have been suggested by Bertaux (on generational occupational mobility) and also by Doreian. Patricia Kendall (1954, Appendix, and also in Chazel, Boudon, Lazarsfeld, 1970), proposed an index of turnover based on latent structure analysis. In Conflict and Mood, she mentions two indices, of common parentage: one applicable to the case of unchanging marginals, and one which pertains to the "pure trend" case - when marginals do, or can, change in one direction only (e.g. younger people can become older but not the

A dramatic example of turnover in terms of quasi-panel results is obtained from this author's research in Colombia. In 1964, 1000

other way around). Only the latter index is discussed in the French source cited. Theodore W. Anderson (1954) suggested an approach via simple Markoff chain models. The simple turnover table with changing marginals (that is marginal differences between the initial and subsequent observations) can be "projected" to a terminal state matrix in which the process is equiliabrated - as many people can be expected to change in one direction as in the other, with resulting marginal stability. Anderson assumes that the transition probabilities (a_{12} and a_{21}) remain constant. Then, the proportion of people in state 1 on the initial observation will be, in the equilibrium matrix, $p_{1e} \frac{a_{21}}{a_{12} + a_{21}}$, and those in state not-1 will be, correspondingly, $p_{\bar{1}e} = \frac{a_{12}}{a_{12} + a_{21}}$. Under these assumptions, in Table 1., this stable-state (equilibrated, or terminal) matrix would turn out to be:

	Expect War	Do not expect war	Total
Expect War	319	80	399
Do not expect war	80	125	205
Total	399	205	604

James S. Coleman (1964) begins by considering m-th order Markoff chains (in which transition probabilities between t and t+1 depend on the states of prior m time periods) and goes on to explore the modeling implications of introducing response uncertainty and Markoff processes into the same dynamic system.

Indirectly, Coleman (1964b especially) also suggests alternative turnover measure by postulating transition rates rather than transition probabilities, that is, allowing for changes to occur not only on time-distinct occasions but at any point in time between the observations. The transition rate model yields

$$q_{12} = a_{12} \frac{\ln (1 - a_{12} - a_{21})}{t (a_{12} + a_{21})}$$

(for shifts from state 1 at the initial time to state 2 in the repeated observation), and q_{21} is the same except that the fraction is multiplied by a_{21}. In this equation, ln is the natural logarithm, the a_{ij}'s are as previously defined, and t represents the time period between the observations in some appropriate units of time (e.g. t = 2 months, t = 2 weeks and the like). The transition rates resulting are then stated in terms of change probabilities per unit time (t - that is, per month, per week etc.).

Coleman's models go further than this, of course: just in the way of indication, Coleman also "decomposes" the transition rates into the

(probability sample excluding the Amazon territory) Colombians were asked about their satisfaction with "social, political and economic conditions" of their country, thus, with life in general in Columbia. They were also asked to "recall" how satisfying were the conditions two years prior to that (about 1962), and to anticipate the satisfactoriness of life conditions in two years (1966) -- and in five years (about 1970). Table 2A gives the panel-like data for the recall (1962 conditions) and the then-current state of affairs (late 1964), and Table 2B, for the 1964 and the expected (1966) situation.

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effect of one variable upon another and a "random shock," and thus provides clues to procedures by which one could separate random shocks (which would result in turnover in about the same magnitude from one position to another, but "basic" marginal stability) from effects (which would produce "trend" separated from such oscillatory, random-shock, turnover). We will not attempt to replicate here the important contributions of Coleman and the reader is well advised to go to the original sources.)

Table 2.*

SATISFACTORINESS OF LIFE IN COLOMBIA: QUASI-PANEL DATA

		1964 (Actual)			1966 (Expected)		
		Satisfied	Not Satisfied		Satisfied	Not Satisfied	
1962 (Recall)	Satisfied	58	478	536	64	28	92
	Not Satisfied	34	420	454	303	595	898
		92	898	990	367	623	990

1964 (Actual)

*Ten respondents failed to answer one of the three questions. "Satisfied" here means that the respondents gave an answer of (+1, +2 or +3) on the satisfaction scale. "Not satisfied" includes those who gave "negative responses" (-1, -2 and -3) as well as those who claimed to be "neither satisfied nor dissatisfied" (scale value 0).

Here is a system (of satisfaction evaluations over time as observed, however, at one point in time only) that undergoes impressive changes. Why were so many Colombians thinking of the past (1962) as so much better than the present (1964)? Who were they? Why did, in turn, so many of those who were dissatisfied at the then-present time (1964) anticipate improvements (into 1966) who were they?

As with the war expectation table, this quasi-panel table begs for interpretations. We know, for instance, that Colombia experienced a major inflation prior to 1964 (an inflation which, in fact, was to continue -- but the 1964 subjects could not have been certain of that); we know that there was an increase in La violencia in the nation's countryside; and so on. Are these the types of processes which help account for the pessimistic shift between 1962 (recall) and 1964 (actuality)? We know that Colombians were to have an election in early 1965, and due to the particular political system, a liberal candidate would become President unless the National Front government were to be

defeated anyway. (The National Front was not defeated. A liberal became President. Most Colombians profess a Liberal Party political preference.) All this, of course, the respondents also did not know for certain (save for the country's propensity to prefer the Liberals in a ratio not unlike that between the Democrats and the Republicans in the United States). Were the hopes for a liberal President and the kinds of policies which might result the main reason for which the 1964 (actuality) gave way to rather optimistic expectations (1966 anticipations of the respondents)? Again, these are the kinds of questions to which panel analysis (including quasi-panel data) addresses itself to, but the "answers" are the better the more the researcher will have incorporated information about (other) past changes or other salient expectations into the design of his project to begin with.

Some 32 per cent of the Elmira respondents changed their view between the interviewees. In the Colombian quasi-panel example, 51.7 per cent of all respondents changed their views (in evaluating, by recall, the past relative to the 1964 present) - most toward "pessimism." In turn, 33.4 per cent changed their views when we compare the 1964 assessments with the expectations - and most, in this case, toward optimistic ratings. Analytically speaking, we may now wonder about the changers in general. Obviously, we can compare the characteristics of the changer with those of the stable respondents.[4] We are led toward elaborating the results.

ELABORATION

When we introduce some additional variable(s) into our analysis, we are elaborating the data in terms of such a variable. Thus we may

elaborate the war-expectations table, for instance, by sex. This means that we would look at the behavior of men on one hand, and that of women on the other hand. We may elaborate by educational level, and study separately (though in relation to one another) people with high, medium, and low levels of education. We may have elaborated by family agreement or conflict: that is, analyzed the respondents with respect to two categories. Some come from families in which their spouses agree with them (share the same expectation); others from groups in which their spouses do not agree.

This, of course, amounts to saying that we "elaborate" the initial results by the incorporation of a third, fourth, n-th variable, and by two, three --- n variables simultaneously.

The items employed in elaboration of panel data are referred to as qualifiers. It is fruitful to differentiate constant, intervening and concomittant qualifiers. Let this be made clearer: sex is obviously a constant qualifier. In effect this means that constant qualifiers are items which do not change, or cannot change, over the duration of the panel investigation. In this sense, educational level is a constant qualifier - unless we study people over a prolonged period of time over which the education of some subjects may change considerably (as would be true for students included in a panel). Religious affiliation is, too, a constant qualifier. Some "constant" qualifiers are stable only by definition. That is, we can consider as constant qualifiers any and all variables (and their combinations) whose initial state is used in the elaboration. For example, we can elaborate "war expectations" (as in Table 1.) by such things as opinion whether or not the United Nations Organization will, or will not, succeed in helping to create a better climate for international peace. Indeed, this attitude toward United

Nations may itself change over time, but when we use its initial (time one) state for the purpose of elaboration, it becomes "quasi-constant", or, in fact, "constant" in terms of the analytical procedure. For we look at the "war expectation" changes in terms of initial estimates of United Nations success.

Similarly, "past" data may become initial, or quasi-constant, qualifiers. In the Colombian quasi-panel, we can elaborate the 1964 (actual satisfaction assessment) and 1966 expectations by the recall of what Colombia was like in 1962 (past, by recall).

Hence, three-wave panels will often use the first wave data as the constant qualifier - thus aiding in the analysis of the relationship between the second and third waves. In social mobility tables, grandfather's occupational status may be a useful qualifier for the relationship between the father's and the son's status.

Intervening qualifiers are events which occur between the two (or any two) panel interviews. Thus the Berlin blockade may be considered an intervening event, and had its influence been studied, we may have elaborated the findings by degree of interest in the Berlin situation, or by knowledge about it, or in some such appropriate manner.

It follows that normally we can distinguish between exposed and unexposed people. For instance, the criterion of the Kendall research on the influence of the film Gentlemen's Agreement was level of tolerance. In the second interview, the respondents were also asked whether they did or did not see the movie. Thus some became "exposed" people, and others "unexposed". Typical intervening qualifiers are consequently exposure to a film, speech, advertisement, educational campaign, awareness of interceding events (Berlin blockade, Stalin-Tito break, Sputnik, change in price level of a product, and so on).

When intervening qualifiers are used, we are studying the effects, influences, impacts of the referent event(s). Such panels are called impact panels. They reasemble, in design, to before-after laboratory experiments wherein some stimulus is introduced between two criterion-observations so that its effects can be singled out for closer analysis. Yet, impact panels differ from laboratory experiments in that they involve no controls over other possible influences. In fact, the two designs, before-after experiment and impact panel, address themselves to somewhat different problems - both of which are quite important.

Under laboratory conditions, we study the impact of a stimulus given exposure of the subjects to it (at least in the experimental group). In impact panels, we study the effects of a stimulus on subjects who expose themselves to it.

Finally, concomittant qualifiers are items which themselves may change in the course of the study. Typical qualifiers of this kind are other attitudes. In the war-expectations example, we would think of a large number of appropriate concomitant qualifiers: for instance, attitudes toward the Soviet Union.

Methodologically, the use of different qualifiers may call for somewhat varying approaches. It has become customary to measure constant qualifiers at the time of the initial interview. Ideally,we would want to measure exposure to intervening events when such events take place - that is, between the actual panel interviews. Mainly for budgetary reasons, the intervening qualifiers tend to be observed in the second-wave interview. We ask people whether they did or did not see a movie, hear a speech, read an advertisement. The sole weakness of the procedure is related to the often observed fact that human memory often plays havoc with the researcher's data. People do not always remember, or

do not recall accurately, their relevant "exposures". Last, the concomitant qualifiers are measured on both occasions inasmuch as they are items which, like the criterion, could change.

It becomes clear from the above that concomitant qualifiers are actually criteria as well, and that it only procedurally important to think of them along somewhat different lines.

If constant qualifiers lead to the comparison of different groups, and impact qualifiers to the study of influences of external events,concomitant qualifiers are admirably suited to the analysis of mutual effects of variables.

Hence, three formal aspects of elaboration may now be briefly considered:

(1) When we differentiate the respondent by some third variable, we study conditional turnover.

(2) When we divide the subjects by their position on the first interview, we speak of conditional effects analysis.

(3) When we study the interaction of variables, we speak of mutual effects analysis.

CONDITIONAL TURNOVER ANALYSIS.

Our basic panel table is divided in terms of some third variable, some constant qualifier. Thus we arrive at separate turnover tables for Catholics and Protestants, for men and women, for upper, middle, and lower class people.

In effect, turnover is somehow measured and compared among such qualifier groups as to magnitude as well as direction. Thus we may find that Catholics are less (or more) stable in their voting intention than Protestants. And we may find that Catholics, if they change

from Republican to Democratic intentions more then in the opposite direction, whereas Protestants - if they change - shift more from initial Democratic position to Republican intention.

Given some basic panel data, numerous qualifiers can be employed: sex, age, education, religion, socioeconomic status - to name again but a few. With respect to the criterion, some qualifiers will differentiate the groups, others will not. There is a sense in which conditional turnover analysis aims at locating qualifiers which are functionally significant for the given criterion.

Several basic results deserve mentioning explicitly. Let us assume an elaboration variable which is a dichotomy (e.g. Protestant, Catholic; or Male, Female and the like - "dichotomized variables will do, too).

We may discover that turnover is the same regardless of the elaboration variable. Thus it seems reasonable to argue that such a variable is non-relevant in the explanation of changes. If Protestants and Catholics, males or females, blacks and whites, educated and less educated people change at the approximately same rates, the particular variable does not seem to allow us much leeway in substantive interpretation of what is going on. (Of course, if still another variable were introduced, for instance, Protestant-males, Protestant-females, Catholic-males and Catholic-females, the results might be different, but we will not deal with all these important ramifications of n-th order analyses because this would be well beyond the scope of this discussion.)

We may, in turn, discover that the turnover is different for the conditional subgroups, but that it is, in effect, in the same direction. We might then ask why it is that males (for example) would

be less likely to change than females - even though the result as stated above postulates turnover in the same direction, if of different mangitudes. Thirdly, we may find that one qualified subgroup (e.g. Protestants) is characterized by essentially "oscillation" only - that is, about as many changes in one direction as in the other, thus producing relative stability in the (Protestant) marginals, while the net marginal change (trend) is accounted for by the other group only, or primarily (Catholics, in this example).

Finally, we may postulate turnover in opposite directions given the elaboration variable. This is a situation in which one group (for instance, males), would be inclined to become "more optimistic" and females, as the other group, would tend to become "more passimistic." Upon elaboration, the qualified tables produce "opposite" results.

Constant qualifiers may be <u>associated</u> with differential stability of the respondents, but they cannot <u>explain</u> it. This is an obvious but crucial point: an unchanging item cannot well help explain changes.

This statement does not affect our statistical reasoning (whereby such associations do get established), but it has considerable consequences on substantive interpretation of the data. Two basic directions appear indicated:

(1) If the marginal distributions remain the same in the qualifier groups, although there are differences in relative turnover (magnitude, direction or both), we are substantively led to ask ourselves questions fundamentally related to the theory of social roles. For instance, what in <u>being Catholic</u> (as a process) may account for the expectation of greater, or lesser, stability in terms of the criterion?

It becomes fairly clear that we employ the qualifier as constant methodologically, but use its process aspects (which turn out to be role-aspects) in interpretation.

(2) If the marginals are unstable - hence trends occur in addition to turnover - we cannot actually reason in the same way as before. For the social roles involved, say "being a Catholic" (role of a Catholic), are themselves relatively stable: their definitions do not change very rapidly. Thus once again: fairly stable normative expectations associated with the qualifier roles cannot explain both the trends and the turnover.

With changing marginals, we are directed by the logic of the problem to look for external events intervening between the interview waves which for cogent reasons appear related to the results. Our case will be much stronger were we to anticipate potential events and incorporate them in our original design. Our case will rest on a speculation, nonetheless very useful, if we locate such events ex post facto[3]

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[3] If we name the criterion 1 (observation initially) and 2 (subsequent observation), and the qualifier 3, we can consider the conditional turnover analysis in terms of the difference of effects (of 3 upon the relationship between 1 and 2).
Then,

$$f_{12.3} = \frac{P_{123}P_3 - P_{13}P_{23}}{P_{13}\,P_{\bar{1}3}}$$

and

$f_{12.\bar{3}}$ same as above except for the barred designation relative to the qualifier (the bar means, of course, non-3: if 3 is "Protestants," non-3 = $\bar{3}$ is non-Protestants).

The overall effect measure is then

$$f_{12.3} - f_{12.\bar{3}}\ .$$

In the above, P_{123}, of course, refers to units who are "1" (positive on 1), "2" (positive on 2) and "3"(positive on 3), relative to the total panel size (the percentage of those who are 1 and 2 and 3). The same applies to the other P_{ij}'s in the f-formula. [By the way, it follows that such terms as $P_{12\bar{3}}$ would refer to those would are "1", not "2", and "3" and so on]. The reader is advised to study Lazarsfeld's

CONDITIONAL EFFECTS ANALYSIS:

We can ask ourselves: given some initial position on the criterion, how do respondents exposed to some event compare with unexposed subjects by the second wave interview? Let an example be used.

Table 3.*

EXPOSURE TO "GENTLEMEN'S AGREEMENT" AND RACE TOLERANCE (10)
(Transition Probabilities Given in Parentheses)

	First Interview					
	INITIALLY HIGH TOLERANCE			INITIALLY LOW TOLERANCE		
	Second Interview					
	High Tol.	Low Tol.	(N)	High Tol.	Low Tol.	(N)
EXPOSED	49 (.86)	8 (.14)	57	15 (.26)	43 (.74)	58
UNEXPOSED	121 (.70)	52 (.30)	173	47 (.22)	161 (.78)	208

*Adapted from source.

Irrespective of exposure, the total panel displays a minor trend (of 0.4 per cent) toward increased tolerance. Our turnover index yields .51. If we look at exposed and unexposed people separately (qualify by exposure), we notice that exposed people moved more into the tolerant position (6 per cent trend), while unexposed people moved slightly in the opposite direction (1 per cent trend). Turnover was larger for the unexposed (.52) than for the exposed subjects (.40).

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discussion of Analysis of Attribute Data in the International Encyclopedia of the Social Sciences for more details.

The question then is: given 3, what is the relationship between 1 and 2 as contrasted with the relationship given not -3 ($=\bar{3}$)

In general, $f_{ij.k} = \dfrac{P_{ijk} P_k - P_{ik} P_{jk}}{P_{ik} P_{\bar{2}k}}$

There exists also some evidence of self-selection. Among exposed people, the proportion of initially tolerant subjects is .50, while it is .45 among the unexposed subjects. Thus less intolerant people show a slight propensity to become exposed to a film which dealt, subtly but very clearly, with the problem of intolerance.

In conditional effects analysis - our next step - we inquire into the comparative magnitude of two effects: preserving effect of exposure, and its generating effect. It is now meaningful to wonder whether exposure to the film tended to preserve a tolerant position better than it helped to convert initially intolerant people (thereby generating tolerance).

We find that there was both a preserving effect (.86 - .70 = .16), and a generating effect (.26 - .22), the former exceeding the latter. Although the indices of preserving and generating effect are separately indicated, they are not independent of one another. Hence the added finding in conditional effects analysis is not that there were both effects present, but that the exposure preserved high tolerance better than it generated it from among initially less tolerant subjects.

One final note: while it makes sense to attribute the trend toward tolerance among exposed people to the impacts of the film, it will not do to explain the trend toward greater intolerance among unexposed people by the fact that they did not see the movie! Once again, we would want to consider other events operative in the environment which could explain the drift of unexposed people toward lessened tolerance. This, like before, is an issue in interpretation of results, but not in the methods of establishing them.[4]

[4] In the language of "effect coefficients" which we have used previously, the conditional coefficients (that of the preserving effect of

In an ideal sense, an impact panel presupposes data acquisition just prior to some (for theoretical or pragmatic reasons) significant event and right after its occurrence. This is an aspiration rarely, if ever, met in actual research. But if transition rates are used as clues to turnover per unit time, some hypothetical solutions are possible. For instance, Coleman (1964b, esp. pp. 140 ff) considers the impact of a film (to explain to American soldiers that WW II in the Pacific might well last quite a while) by comparing a "control" and an "experimental" group, exposed and unexposed to the stimulus respectively.

Changes are observed in the control group as well as in the experimental group: by asking himself what the experimental group would have been like were it not for the exposure to the film (a stimulus which was induced one week after the initial inquiry), Coleman is able to show what amounts to the "net" effect of the

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exposure and that of the generating effect) can be expressed as

$$f_{E2.1} = \frac{P_{E21}P_1 - P_{E1}P_{21}}{P_{E1}\,P_{\bar{E}1}} = \text{(preserving effect)}$$

and

$$f_{E2.\bar{1}} = \frac{P_{E2\bar{1}}\,P_{\bar{1}} - P_{E\bar{1}}\,P_{2\bar{1}}}{P_{E\bar{1}}\,P_{\bar{E}\bar{1}}} = \text{(generating effect)}$$

where E and $\bar{E}$ stand for exposure and non-exposure, 1 and $\bar{1}$ for initial position (in the example, higher and lower tolerance at the time of the first interview), and 2 and $\bar{2}$ for the subsequent position (in the example, higher and lower tolerance on the second occasion).

This means that in impact panels, the turnover table is qualified by the initial position of the unit. From the data of Table 3., using frequencies rather than percentages, we have

$$f_{E2.1} \text{ (preserving effect)} = \frac{49*230 - 57*170}{57 * 173} = .16$$

There are 49 people who are "E21", that is, initially higher in tolerance (1), exposed (E) and subsequently higher in tolerance (2); there are 230 people who are "1", hence, initially more tolerant; and so on.

stimulus (it is not the net effect because the impact of other intervening stimuli could not have been explicitly taken into account in the analysis). He uses the control group transition rates to generate a panel table for the exposed group as it would have looked after six days, that is, prior to the film stimulus introduction, so as to differentiate between the molecular processes of the period and the "event impact" itself. He finds it important (and we agree with him) to distinguish between events which produce immediate effects (those which alter the factual basis of evaluation) and "sleeper" effects, (those which have an impact after some duration: (events which affect more general attitutes).

This means that we can suspect that occurrences which change cognitions have an "immediate" effect though not necessarily lasting, whereas events which affect evaluations may have a "sleeper effect" wherein the changes do not become manifest until after some time after the introduction of the stimulus - whether or not such effects "last" is, too, an empirical question (of prime importance).

MUTUAL EFFECTS ANALYSIS

While we speak of a difference between preserving and generating effects in our inquiries into the influence of stimuli on the criterion, we shall now deal with harmonizing and disharmonizing effects. Mutual effects analysis utilizes, as we have pointed out, concomittant qualifiers.

Another example will be helpful: (Berelson, Lazarsfeld, McPhee, 1954)

Table 3.

POTENTIAL DEMOCRATS IN ELMIRA SALIENCY OF CLASS ISSUES AND IMAGE OF TRUMAN

October 1948

Earlier Time: Truman Image (June)	Class Issues: Salient Favorable (A)	Sal. Unfavor. (B)	Not Sal. Favor. (C)	Not Sal. Unfavor. (D)	TOTAL (Aug)
(A) Salient-Favorable	20	2	8	1	31
(B) Salient-Unfavorable	6	7	3	6	22
(C) Not Salient-Favorable	52	14	54	23	143
(D) Not Salient-Unfavorable	16	37	19	60	132
TOTAL	94	60	84	90	328

Although numerous statements can be made by inspecting the marginals, and all rows and columns, this is not our primary purpose. Let us look at the people with conflicting attitudes (Salient-Unfavorable; and Not Salient-Favorable). Since class-issues have been identified more with the Democrats than with the Republicans, and since Truman amply stressed them throughout the campaign of 1948, we may wonder about the manner in which these conflicts get resolved. Thus we study row vectors (B) and (C) first to establish harmonizing effects.

For people in (B) chances are equal that they adjust their image to saliency of class issues (6 subjects move to call BD)or favorableness of the image to perceived saliency (6 move into BA). But for respondents in row (C), favorable images are maintained much more often while saliency of class issues increases (52 subjects move to CA, but only 23 to CD). On the whole then, considering both rows, the cross-pressure resulting

from a conflict between perception of issues and image of the Democratic candidate tends to be reconciled by adjusting saliency to the image. This we refer to as the harmonizing effect.

Inspect next rows (A) and (D). Some people with initially consistent positions move into disharmonious ones. By the same reasoning we arrive at the conclusion that, once again, disharmonizing effect occurs chiefly by changing saliency of class-issues, and that the image of the candidate is more stable (than saliency).

Finally, look at cells BC and CB in which are subjects who reversed their conflicting positions. Fourteen respondents with a favorable image but low saliency of class issues increase their awareness of class issue but also changed their image of Truman from favorable to unfavorable. Substantively we may argue that the candidate was able to make people aware of class-issues, but that he lost some-voters "because" of that.

Thus to analyze for harmonizing effects, we inquire into the manner in which respondents with initially conflicting attitudes reconcile them. To study the disharmonizing effects, we look at the movement of subjects originally with consistent positions. (Lipset, Lazarsfeld, Barton and Linz, 1954, Morris Rosenberg, 1955)

Let us use (++) for responses which fall into row A (Class issues relevant, Truman image favorable on the first occasion), (+–) for B, (–+) for C, and (––) for D. The same, of course, applies to A, B, C and D columns of the Table (for viewpoint on second occasion). Then changes (+–) → (+ +) and (– +) → (– –) can be said "good for the first variable" (class issue relevance in this example): these changes, in cells BA and CD of Table 3., indicate that the "first variable" dominates the second one in that it harmonizes with the state (+ or –) of the first variable.

Similarly, changes (+ -) → (- -) and (- +) → (+ +) are "good for the second variable": cells CA and BC indicate the extent to which the first variable harmonizes with the second one.

In turn, we can say that changes (+ +) → (- +) and also, (- -) → (+ -), in cells AC and DB respectively, are "good for the first variable" while changes from (+ +) → (+ -) and (- -) → (- +) are "good for the second variable". Here, relative dominance of a variable is reflected in its greater freedom, so to say, to detach itself from a harmonious position with the less dominant variable. In harmonizing effects, the stronger variable is assumed to "pull" the weaker variable toward harmony, whereas in disharmonizing effects, the stronger variable is less "attached" to remain in harmony with the weaker one.[5]

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[5] The most recent formulation of appropriate-indices is given by Lazarsfeld (1971). See also Levenson's article in the International Encyclopedia.

Let us use the letter designations of cells (AA, AB . .) as we have done in discussing Table 4. For the sake of convenience, we express the cell entries as proportions, hence, AA = $P_{1234} = P_{++++}$ (proportion of people who are "1" and "2" and "3" and "4", that is, [++ ++], and so on.

Then,

$$h_1 = \frac{BA * CD - BD * CA}{(BA + BD)(CA + CD)}$$

is the "harmonization effect" component of the mutual effect index, and

$$h_2 = \frac{AB * DC - AC * DB}{(AB + AC)(DB + DC)}$$

is the "disharmonization effect" component, and

$$ME = h_1 - h_2$$

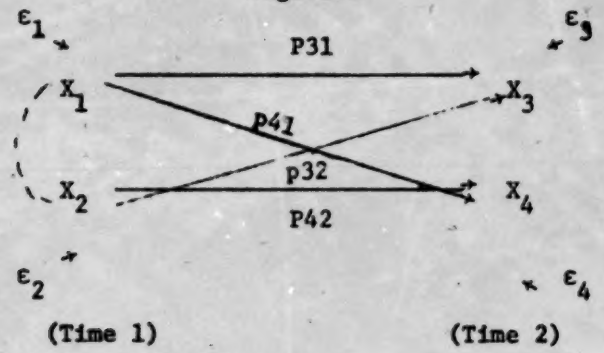
with h_2 subtracted from h_1 because, in line of our reasoning, we wrote the h_1 index in terms of "first variable" dominance, and h_2 in terms of "second variable" dominance.

(e) 16-Fold Tables: Further Considerations

Following Simon's seminal paper on spurious correlations (1954), a great deal of emphasis has gone since into the development of appropriate causal models in sociological analysis (see especially Blalock, editor, 1971 - as well as other references provided in the bibliography).

One of the earliest approaches, relevant to panel analysis, was suggested by Campbell (1963): the cross-lagged correlation.

Figure 2



The reader will note that the numerators of the component indices are cross-products (determinants) involving the critical change cells, and the denominators are the variances of the initial time period (based, of course, on marginals for people in the critical "effect" cells only.

Lazarsfeld (1971) has now preferred to call h_1 the index of relative concurrence (rather than "harmonization"), and h_2, the index of relative attachment. This has been prompted largely by the fact that designations of "harmonious" and "disharmonious" positions are somewhat arbitrary (for instance, we could call "unfavorable Truman image" a [+] rather than a "favorable" one -- this would yield [++] as a position in which the respondent does not like Truman and considers class issues relevant; and so on).

I am still going to stay with the older (harmonization/disharmonization) terminology. Usually, as a criterion for determining which position "should" (pragmatically, not normatively) be considered "harmonious", I suggest that the initial correlation of the variables be used. (Hence, if initially "class issue relevance" and "Truman favorableness" correlate, as they do somewhat in Table 4., the harmonious position would be "relevant-favorable" and "non-relevant-unfavorable". But the reader may well wish to adopt the new terminology (of relative concurrence and relative attachment).

To keep within the convenient, if new tradition we will use X_1 and X_3 ("odd" numbers) for the successive observations of one variable (such as "relevance of class-related issues" in Table 4.) and X_2 and X_4 ("even") for the reobservations of the second variable (Truman image, as in Table 4.).

Campbell argues that if X_1 has more effect on X_2 than the other way around, then the correlation, r_{14} should be greater than the correlation r_{23}, hence $r_{14} > r_{23}$.[6]

One of the main difficulties with the approach as it applies to the study of mutual effects in panel tables has to do with the fact that the (raw) correlations do not take the relative stability of the variables into account (see, for example, Heise, 1970; Lazarsfeld, 1971), and the results might well be misleading (see Pelz and Andrews, 1964). Hence, Pelz and Andrews suggest the use of partial cross-lagged correlations, that is, specifically $r_{14.2} > r_{23.1}$ if the "odd" variable is stronger, and $r_{14.2} < r_{23.1}$ if the "even" variable is stronger. But this, in turn, does not take into account the dynamic of the "independent" variable, its "behavior" over time. Heise's approach (1970) is quite

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[6]This is, of course, called "cross-lagged" correlation because of the arrows which link, in the way of a causal hypothesis, X_1 with X_4 and X_2 with X_3 in Figure 2.

Campbell deals chiefly with quantitative variables, hence, the use of correlations. In the language of the effect coefficients, the argument is that $f_{14} > f_{23}$ The e_1 terms (arrows which go to each variable from the outside of the main diagram) are "error" terms, or better yet, they represent the effects of all variables other than those (X_1, X_2, X_3, X_4) explicitly considered.

For later convenience, we have also labelled the "paths", p_{11} -- these are path coefficients, and we will have an occasion to mention them subsequently.

similar to that of Pelz and Andrews except for his use of path coefficients in place of partial correlations. The limitation (of not taking into account the changes in the qualifier - itself a panel study criterion) previously mentioned, however, applies as well.[7]

Boudon (an elegant simplification of Coleman, 1964) bases his model on considering the "inertia" (Boudon's term; Lazarsfeld's term would be "stability") as the effect which a variable, say x_1, has upon remaining in the same state, x_3 (rather than changing into $x_{\bar{3}}$); the effect which x_1 and x_2 have upon each other -- and the e-factors (see Figure 2.), the factors which are not explicitly taken into account.

The results then lead to estimating the inertia terms (for each variable, x_1 and x_2, that is "X-odd" and "X-even"), the cross-effect terms (effect on x_1 upon x_4, the latter being the second observation on

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[7] Consider Figure 2. again. Let us use p_{31} for a "path co-efficient" linking x_1 and x_3 . . . and so on. Then,

$$r_{13} = p_{31} + p_{32}\, r_{12}\ , \text{ and}$$

$$r_{32} = p_{32} + p_{31}\, r_{12}, \text{ and so on.}$$

Now (see Lord, 1969), subtracting $(p_{32} r_{12})$ from the first equation and substituting in the second (similarly, by subtracting $p_{31} r_{12}$ from both sides), and by simplifying, we come up with

$$p_{31} = \frac{r_{13} - r_{12}\, r_{23}}{1 - r_{12}^2}$$

Similarly, the other path coefficients, p_{32}, p_{41} and p_{42} can be determined.

$$p_{32} = \frac{r_{23} - r_{12}\, r_{13}}{1 - r_{12}^2}$$

and so on. [We are "cheating" a little bit. The correlation coefficients are really the "true" correlations, rho, but we have expressed the path coefficients in terms of real data, the empirical p_{ij}'s which are used to estimate the r_{ij}'s]. The reader is advised to consult both the Lord article, and Heise's paper directly.

x_2; and similarly, the effect of x_2 upon x_3), and the e-terms, as residuals.[8]

While these indices thus provide interesting insight into the properties of the 16-fold (mutual effects) table, these are pieces of information in addition to, and complementary to, the mutual effects index which Lazarsfeld has proposed, and which has been discussed in the previous section of this paper.

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[8] Paraphrasing Boudon (and also Lazarsfeld (1971), we find that the basic equations are of the following form:

1. $P(X_4;\ X_1\ X_2) = a_{14} = a_{24} = e_4$

Here the P( ) term states, of course, the probability (transitional) of being in X_4 given than the individual is in X_1 and X_2 initially. Going back to Table 4. : P( ) is the proportion of people who have a favorable Truman image on the second interview occasion among those who considered class issues relevant (X_1) and, at the same time, had a favorable Truman image (X_2) initially.

Similarly,

2. $P(X_4;\ X_{\bar{1}}\ X_2) = a_{24} + e_4$

3. $P(X_4;\ X_1\ X_{\bar{2}}) = a_{14} + e_4$

and

4. $P(X_4;\ X_{\bar{1}}\ X_{\bar{2}}) = e_4$

To make sure that the terms are understandable, the reader must recognize that Boudon uses a a_{12}^{11} for "stability" (or "inertia" of the first variable netween the interviews: Since we use "X-odd" and "X-even" here, this term becomes a_{13} (with the 1-subscript representing the "odd variable" at the first time, and the 3-subscript standing for the same variable the second time; thus a_{14} in our terminology, for the effect of initial state of the "odd variable" upon the subsequent state of the "even variable", would be - in Boudon's symbology - a a_{12}^{12}: the superscripts having to do with the observation times, 1 and 2, and the subscripts with the variables.

Furthermore, to make clear the meaning of the equations, let the first one be used, that is,

1. $P(X_4;\ X_1\ X_2) = a_{14} + a_{24} + e_4$

It says that the "odds" of being X_4 given that the individual is $X_1 X_2$ to begin with are a simple linear function of the effect which variable

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on (initially) has on variable two (subsequent), a_{14}, of the "inertia" of the second variable, a_{24}, and of the effects of everything not explicitly considered in the model upon the second state of the "even variable", e_4 (Note that the arrow from the outside of the diagram toward X_4 in Figure 2 is designated as e_4).

We can get a_{24} by substracting equation [3] from [1], but also by substracting [4] from [2]. This means that

$$P(X_4;\ X_1X_2) - P(X_4;\ X_1\bar{X}_2) = P(X_4;\ \bar{X}_1X_2) - P(X_4:\ \bar{X}_1\bar{X}_2)$$

and this is, indeed, quite a restrictive assumption (built into the model). A parallel equivalence will be found, of course, by considering the $P(X_3;\ xx)$ terms.

IV. On Elaboration: Further Considerations

While the logic of the analysis should make the point clear without the need for discussion, it may be worthwhile to mention some of the additional, if obvious, implications.

In the analysis of "conditional turnover," we have talked about elaboration by the first, second, third... n+th variable, and by two, three, four... n-variables simultaneously. These elaboration variables were initial, or constant, qualifiers.

It follows that similar elaborations of impact panel tables will lead to information about impact conditional not only upon exposure/non-exposure, or awareness/non-awareness (as related to some event(s)) but also upon initial qualifiers. Thus, we can look at impact tables themselves elaborated by some initial qualifier(s) in order to determine whether, for instance, the event impact in one group (for instance, among males) varies from the impact in another group (for instance, females). Similarly, a 16-fold mutual effects table can be elaborated by initial qualifier(s)[9]

Also, such mutual effects tables can be analyzed by elaborating them by "impact," that is, by exposure to some event(s). Or, for that matter, by elaborating them by impact and by some initial qualifier(s).

The point is really that the analytical procedures mentioned in this discussion build upon each other, and the researcher does not consider "either" conditional turnover, or conditional effects, or

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[9]Coleman, for instance, (1964, pp. 168ff) considers the interaction between "membership in the leading crowd" and "having to go sometimes against one's principles" -- this being a mutual effects table when at least two time observations on both variables are involved -- in terms of sex (boys and girls: this being an initial qualifier).

mutual effects analyses but rather, the appropriate mixes which test the theories under question.

V. Corrosion and Oscillation

We have dealt with two-interview situations entirely. The reader may wonder whether changes so discovered represent mainly cyclical movements of people, oscillations, or whether some given proportion of respondents actually moves into a different position as time goes by.

Third wave interviews can help answer such questions. If the association between the first and second wave is of similar magnitude to that between the first and third interview, we can speak of <u>oscillation</u> — of people moving to and fro between the available criterion positions. If the association between the first and third interview exceeds that between the first and second interview, we can speak of <u>corrosion</u>.[10] The former schema (oscillation) is compatible with the notion of basically stable marginals with turnover of people, whereas the concept of corrosion implies also a trend -- for instance, one whereby majorities are formed and increased as time goes by.

Although by far too few properties of n-wave panels (n>2) have yet been systematically studied, Lee Wiggins (1956) has developed a

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[10] In the absence of third-wave data, consider the McNemar (Chi-square) statistic. If there were, by chance, about as much movement from one position to another as the other way around, the <u>expected</u> value would be, in frequencies, 1/2 ($n_{12} + n_{21}$) where the n_{ij}'s are frequencies observed in cells (12) and (21). In other words, of all the changers, half would be expected to move in one direction and the other half in the other direction. If we have no other (third wave) information, we would draw the conclusion that "oscillation" has taken place if the actual distribution of changers does not depart from the expected one with chances that we would not want to take (that is, the Chi-square is not significant), whereas we might accept the hypothesis of "corrosion" if the actual distribution departs from the expected one by more than tolerable (.05; or .01 or whatever) odds would seem.

number of mathematical models applicable for n-wave panels. The simplest way of treating multi-wave panels seems to be that of using, say, first wave responses as qualifiers for panel tables built around the second and third wave interviews. Undoubtedly, however, much needs to be done to systematize the analysis of n-wave panels. It seems almost fair to say that further major breakthroughs in the study of social change must come by the way of procedures to deal with such data.

VI. A Note On Operational Problems

There are two major issues to be, at least, outlined: one, the participation problem in panel research, secondly, the re-interview effect. The most careful, and by far most important, scrutiny of these problems comes from Charles Y. Glock (1952, 1960; also Lazarsfeld, Rosenberg and Wagner Thielens, 1952) who reanalyzed data from a number of panels from the viewpoint of participation and re-interview biases.

Although panels and surveys alike have their share of problems to insure that selected respondents will actually be interviewed (initial participation), panel research faces the added dilemma of assuring continued participation of the subjects. Glock has been able to differentiate between facilitating and motivating factors operative both with respect to initial and continued participation. Physical and mental capability of subjects to meet the requirements of panel membership seem one such facilitating precondition (especially as regards initial recruitment). Among the motivating factors, Glock concludes that an individual's interest in the panel topic, his response to incentives, his group orientation are of importance.

What is even more crucial, however, is the finding that attitudes, opinions and behavior of continuous participants are different from those of non-members and occasional participants.

In this paper, I will not consider (for want of space) the problem of "unreliability" and "measurement error" in general. But some of the recent contributions which bear on the issue are given in the bibliography.

Although the re-interview bias may present as serious a challenge as the participation problem, adequate solutions are at hand: simultaneously with the panel, control groups can be studied by repeated sample surveys. It does not mean that the problem of re-interview bias thereby vanishes, but at least its direction and magnitude become known.

Conclusion

To say that the panel procedure represents an important advance in behavioral research is to slightly understate the case. When it comes to empirical analysis of social change, we know of no other, and certainly no better, form of design.

Probably the most impressive panel study that has ever been carried out is being done since 1960 under the title of "Project Talent." A sample of 400,000 high school students (9th to 12th grade) has been subjected to two day long interviews and tests on questions concerning various aspects of the educational process. Followup interviews have been taken every year, and every initial participant has been interviewed one year after graduation by mailed questionnaire.

The research design includes additional interviews after 5, 10 and 15 years. The last interviews will be taken in 1983 from those students who were in 9th grade in 1960 (J.C. Flanagan and W.W. Cooley, 1966).

The research design allows for the systematic study of the development of individual careers of young Americans. Not only will there be records taken of the state of careers at certain points in time (such as job satisfaction, satisfaction with the job position, additional education and others), but career plans and plans for future education will also be kept track of . This is in fact a courageously designed project that promises important theoretical and methodological advances. This project offers the opportunity of studying all

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Schoenfeldt's summary article in Social Science Information will provide the reader not only with further data on Project Talent, but also with suggestions how the project data may be acquired by other researchers (1967).

important aspects of attitude change, of the relations between planned and actual behavior, of the effect of time per se, the effects of intervening events and experiences, and the effects of time dependent mutual effects of variables on each other.

Applications of panel approaches to economic problems are well illustrated by such works as those of Morgan and associates on changes in income patterns (1968-1970), Lansing and associates on residential changes, geographical mobility of labor (1966, 1967, 1969), to suggest a few major examples.

Svalastoga has reported on the design of Project Metropolitan (conducted in Copenhagen and Stockholm) with objectives to consider the interaction of such factors as career lines, deviant behavior trajectories, patterns of marital adaptation and the like.

Margaret Mod, in her review of some of the mainlines of sociological research in Hungary, refers to a panel study of 4,000 households (2000 workers and employees and 200 peasant families) selected, as a panel, from among groups surveyed previously by the Central Statistical Office. Eliska Freiova reported on study plane involving 2,597 students entering the University (1966) who were to be re-interviewed in their 4th University year (1969) and again upon graduation (1972).

Given the scale of some of the more recent inquiries, and the methodological advances in analytical procedures, we have now reached the stage in which the study of social processes in the most concrete sense has reached a level of sophis .cation which cannot fail to bring the social scientist's understanding of change phenomena to their properly central role in the enterprise of theory construction and testing.

SELECTED LITERATURE

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